by Paul van der Werf

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Welcome to the Machine

Thermo-chemical approaches to organic waste management

Some interesting technological approaches are being developed to deal with organic wastes that focus on thermo-chemical rather than biological processes. They have the potential to alter the landscape of organic wastes can be managed.

Primarily they offer the opportunity to convert this waste into energy that can be contained for later use and/or development of other chemicals.

The University of Western Ontario's Institute for Chemicals and Fuels from Alternative Resources or ICFAR (cleverly pronounced as "i see far") (**www.icfar.ca**) is at the forefront of this research.

The Institute seeks to be "a leader in the development of technologies and processes for the production of chemicals and fuels from alternative resources" and to "quickly move research from the lab benches to large demonstration projects ... paving the way for Ontario bio-fuel and chemical innovations to get to the global marketplace."

Pyrolysis (thermo-chemical decomposition of organic material at elevated temperatures in the absence of oxygen) is being used at this facility to develop next generation biofuel technologies. Currently the focus is on using waste streams such as agricultural residuals forestry residuals and food residuals, such as corn stover and cobs, to produce a bio-oil which can be turned into a variety of products. Considerable efforts are being made at ICFAR to work at ways of densifying residues to reduce the costs of transportation (from where the biomass is produced to future upgrading facilities). This can include transforming it into a liquid bio-oil where the biomass is produced.

And while we think that energy is the primary natural and possibly lucrative by product, that is only partly true. As Dr. Franco Berruti a co-founder of ICFAR and a University of Western Ontario professor points out, "We need to learn from the petroleum industry. Making fuels does not generate much revenue. Making chemicals does!"

"If you look at petroleum refineries," Berruti says, "70 per cent of petroleum resources generate only 43 per cent of the revenue when utilized for transportation fuels. However, four per cent of petroleum resources generate 42 per cent of the revenue when utilized to produce chemicals."

So at ICFAR the research is focussed on generating fuels but also on the potential extraction of valuable chemicals. And there's more.

"In the process of producing liquids, using pyrolysis, solid bio-char is produced as a co-product. This material is stimulating a great deal of interest, worldwide, as an outstanding soil amendment and fertilizer, as a fuel to potentially substitute coal in power plants, as well as an effective and efficient carbon sequestration technology," says Berruti.

Finally the pyrolysis process generates gas which can be used directly to help to fuel the pyrolysis process itself and make it self-sustainable.

These types of technologies and the products developed can work with existing technologies such as composting.

As Berruti notes, "We are seeing that bio-char produced by pyrolyzing organic materials is considerably enhanced in its value as soil amendment and fertilizer when it is mixed with compost. We truly believe that a very effective way of dealing with organic residues is their transformation into bio-char and compost and in the commercialization of their mixtures."

The R&D work of the ICFAR team has led to the creation of a spin-off company, Agri-Therm Inc. This start-up is dedicated to developing, manufacturing and marketing portable and stationary equipment for producing bio-oil and bio-char from biomass, specifically agricultural residues and transition crops.

ICFAR has now started to tackle municipal solid waste as well.

"The big issue with municipal waste is heterogeneity," continues Berruti. "Gasification and transformation of syngas into methanol and higher alcohols may be a solution."

Some jurisdictions, most notably the City of Edmonton, are headed down the path to gasify a portion of their waste stream. Working with Enerkem Alberta Biofuels, they are in the process of constructing a waste-to-biofuels production facility that's scheduled to open in 2011. The facility will be fed with recalcitrant "organics" such as plastics, rubber, waste wood separated from the residential waste stream (prior to composting) and residues generated from their composting and residential recycling programs.

Gasification of raw municipal waste or organic wastes such as uncomposted organic wastes is not feasible because the moisture content is too high. All of these wastes will first be transformed into a refuse derived fuel "fluff" in an RDF plant (currently under detailed design) prior to gasification. The syngas will primarily be converted to biofuels such as ethanol and methanol. These will be used to help power vehicles. A future column will explore this project in greater detail. (*See article on CLP in the CleanTech Canada section, page 23.*)

The management of organic wastes is clearly moving to more complex yet interesting places. As always it will remain to be seen whether these new approaches represent real, practical and cost efficient solutions. With the fairly constant upward pressure on energy costs it seems likely that at least some of these processes will be viable.

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